-REMARKS FOR ADMINISTRATOR BOLDEN

WILLIAM R. SEARS DISTINGUISHED LECTURE

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Thank you for inviting me to speak here tonight. It's good to see so many people here who care about the future of space exploration and are working in a world-class facility like Cornell to help us create the future. I want to thank Dr. Mason Peck, our former NASA Chief Technologist, for getting me up here.

I'd guess that most of you here tonight share my belief in the power of exploration to shape our future – to make it better and to improve lives and uncover the wonders of the universe for all of humanity.

I've been fortunate to meet with colleagues around the world, especially students in the U.S. and other countries, including nations that do not currently have their own space agencies. It's obvious how enthusiastic both our partners and this upcoming generation are about the possibilities for our future in space.

I recently had the opportunity to attend the International Astronautical Congress in Toronto, and I spoke to hundreds of students and met with dozens more, and I can tell you they are fired up about exploration.

Today's young people are truly the space generation, because they live in a world where there hasn't been a point in their lifetime where humanity had not ventured to space. Even their younger brothers and sisters may not know a time when humans have not lived in space – we're coming up on the 14th anniversary of continuous human occupation of the International Space Station next week. The first crew arrived Nov. 2, 2000.

Space connects us no matter where we live. The young people of today are used to satellites of all types visible with the naked eye at twilight. They're used to smart phones that connect with those satellites and connect them with a world of information and capabilities. NASA has demonstrated, by the way, that those very phones can be effective, low cost spacecraft themselves.

People compare the growth of spaceflight to the growth of aviation. Within 50 years of the Wright Brothers' first flight, commercial air travel was widespread to the average person, and commerce depended on it.

Now, 56 years after NASA was formed, we have regular cargo delivery to low Earth orbit by two companies. We are about three years away from commercial transport of astronauts to low Earth orbit, and that doesn't even take into account space tourism and the private companies that are going to take folks on suborbital flights, perhaps as early as next year.

NASA also has been contracting with flight providers to enable more opportunities for industry, academia and other government agencies to fly payloads to suborbital space – something that will increase access and allow things to be tested before they go all the way to the unforgiving environment of low Earth orbit and beyond.

Those Phonesats and Cubesats I mentioned earlier have demonstrated that low cost, readily available technology can provide some of the benefits that, in the past, required expensive spacecraft and complex missions. It's part of the evolution of our field that much of what once was the province of governments has become available to industry and citizens no matter where they live.

Citizen scientists and inventors are helping NASA with their ideas about asteroids, about Mars spacecraft and about innovative computer software.

When you look at what's really going on in the field, it's incredible how much things have opened up, and so much richness of innovation and inspiration is flooding into aerospace. People all over the world, looking to create the future, are helping NASA continue to do the big things that no one else can.

With all the marvels of technology and innovation that we all take for granted, there is still wonder to behold. There are still marvels to create.

At NASA, we're on a journey to Mars, and I invite you to come along. Many of you in this room are already our partners in that global endeavor.

It was my pleasure last month to congratulate the Indian Space Research Organisation as its Mars Orbiter Mission (*MOM*) arrived at Mars.

Coincidentally, NASA's *MAVEN* spacecraft had also just arrived two days earlier, so we've exponentially increased our potential understanding of the Red Planet in just a single week.
Mars is hard! So these milestones need to be recognized. These science missions are precursors to sending humans there in the 2030s. Our *Curiosity* rover continues to send back incredible science data after demonstrating that life could have been possible on Mars at some point. We're also sending a lander to study the planet's core in 2016 and another *Curiosity*-type rover there in 2020 with participation from France, Spain and Norway.

Any human mission to Mars is going to be a tremendous global effort. Technology drives exploration, and that's why we're making investments in it to make this next milestone in human history a reality.

Our Space Technology Mission Directorate this year made investments focused primarily in eight key technology areas: 1) High-Power Solar Electric Propulsion; 2) Space Optical Communications; 3) Advanced Life Support and Resource Utilization; 4) Mars Entry, Descent and Landing Systems; 5) Space Robotic Systems; 6) Lightweight Space Structures; 7) Deep Space Navigation; and 8) Space Observatory Systems.

You might have seen stories this summer about our Low Density Supersonic Decelerator. People were calling it a flying saucer, and it does kind of look like one, but its purpose was to determine if the test vehicle could reach the altitudes and airspeeds to test technologies that will be needed for landing large payloads on the surface of Mars.

Space Tech also is working with private companies to develop large, flexible, radiation-resistant solar arrays that can be stowed into small, lightweight packages for launch.

Once deployed, the arrays will provide greater solar power to spacecraft than ever attained before. This advanced propulsion project is developing critical technologies to enable cost-effective new trips to asteroids, Mars and beyond.

We're readying NASA's green propellant fuel for launch and testing in 2016 to help us move away from the toxic hydrazine.

Our Deep Space Optical Communication project is developing key technologies for the implementation of a deep space optical transceiver and ground receiver. The technology will enable greater than 10 times the data rate of a state-of-the-art deep space radio frequency system.

Universities continue to play a big role in technology development. The Space Technology Research Grants program has funded research at 86 schools across 38 states with a total of 284 grants since its inception.

NASA's early stage technology innovation catalyst program made 12 Phase I and five Phase II awards across industry, academia and NASA Centers just this year.

But NASA’s path for the human exploration of Mars begins in low-Earth orbit aboard the International Space Station, our springboard to the exploration of deep space. As we speak, astronauts aboard the ISS are helping us learn how to safely execute extended missions deeper into space. President Obama’s commitment to extend the ISS until at least 2024 guarantees we’ll have this unique orbiting outpost for at least another decade.

This means an expanded market for private space companies, more groundbreaking research and science discovery in micro-gravity and opportunities to live, work and learn in space over longer periods of time.

The Space Launch System rocket that will carry our *Orion* crew vehicle on missions to an asteroid and eventually to Mars reached a major milestone in August when we completed a rigorous review and approved the program's progression from formulation to development, a significant milestone on our return to human exploration beyond low-Earth orbit.

I was pleased to travel on the Navy ship carrying an engineering test article of *Orion* on its water recovery tests a few weeks ago. The test simulated how *Orion* will actually return to Earth.

We're making great progress toward *Orion's* first flight test this December, when it will travel farther than a spacecraft built for humans has traveled in more than 40 years, and it will simulate a reentry from a lunar mission. That spacecraft is at the Kennedy Space Center now undergoing processing.

The launch abort system is being installed -- which in the future will protect astronauts should something happen during launch. Next month it will be integrated with its launch vehicle, a Delta IV Heavy.

This will be followed by an uncrewed test flight of the joint Space Launch System/*Orion* in 2018 and the first crewed test flight in 2021.

While NASA is focused on human missions to deep space and to places no one has ever gone before, we are handing over transport to the International Space Station and other low-Earth orbit destinations to those private companies I mentioned earlier. We now are in the enviable position of having two partners successfully launching cargo missions to the Space Station – SpaceX and Orbital Sciences.

The most recent SpaceX mission with a *Dragon* spacecraft atop a *Falcon 9* rocket launched last month carrying supplies and a lot of science, including the *RapidScat* instrument to study ocean winds. *Dragon* is scheduled to splash down in the Pacific this coming Saturday. Another Orbital mission launches next week.

Last month, we also were very excited to announce that the Boeing Company and SpaceX will be the carriers of astronauts to low Earth orbit by 2017. This is an historic milestone and validates our faith and our investment in commercial space.

Commercial space is part of our strategy for a journey to Mars. We're turning access to low Earth orbit over to industry with our oversight and the same strict safety protocols we've always observed. While that's happening, we're working on a mission to redirect an asteroid closer to our moon so astronauts can visit it.

In a lunar orbit, we'll also be testing cutting edge new technologies such as solar electric propulsion in the "proving ground" of deep space, with the ultimate goal of sending humans to Mars.

I've been talking for a while and I still have barely mentioned NASA Science, which even now has spacecraft speeding to Pluto and Jupiter. The James Webb Space Telescope continues to make each milestone on its path to a 2018 launch. Not too far away in the big picture.

It's also been an incredible year in Earth Science, with the Global Precipitation Mission (*GPM*), a cooperative mission with the Japan Aerospace Exploration Agency (JAXA), launched in February to provide measurements of rain and snowfall worldwide. The Orbiting Carbon Observatory-2 (*OCO-2*) launched in July to provide accurate global measurements of atmospheric CO2 levels.

And of course there's *RapidScat*, which I mentioned earlier. Upcoming are the Soil Moisture Active Passive (*SMAP*) mission to study the Earth's water cycle and ISS Cloud-Aerosol Transport System (*CATS*) to study how parts of the atmosphere affect climate change.

Being a pilot, of course I also am incredibly excited about NASA's aeronautics work, which continues to support the Next Generation air transportation system, or NextGen, on which we're working with the Federal Aviation Administration and others to develop technologies to make air travel safer, more efficient and greener.

I'm sure Dr. Sears, for whom this lecture is named, who was also an innovator in aeronautics, would be very interested in everything going on today at NASA to advance the field. We're looking at the big picture -- how aviation fits into a global picture of economic and population expansion and technological innovation.

NASA Aeronautics has developed an exciting new strategic vision that clearly focuses our research on priority challenges in order to benefit society and our nation's economy.

All that I’ve spoken about today just scratches the surface of what NASA is doing in human exploration, technology development and science. The writer Zora Neale Hurston said, “No matter how far a person can go, the horizon is still way beyond you.”

There’s truly much to behold on the horizon, and many of you are at the leading edge of reaching for it. Students committed to science, technology, engineering and math are the hope of our planet.

Some of you are going to help us figure out how to shield astronauts from radiation on the way to Mars. You’re going to help us figure out how to get all that mass to the surface of Mars so humans can set up an outpost there.

You're going to take the data from all of our Earth science missions and help us tackle climate change.

Everywhere I go I meet young people like many of you here tonight, and whom I met today in Dr. Peck's Spacecraft Engineering class, who understand that STEM-educated workers are needed more than ever to solve global problems that cross all borders.

Space exploration strengthens us all, not only with the new discoveries we make, but with the numerous technologies that are developed with applications directed toward improving life on Earth. Besides that, it brings us together as one world and that's worth working toward.

Thank you.